- **Cisco-Summa Four**

  Summa Four -- now part of Cisco Systems, Inc. -- is positioned as a supplier of open, programmable, standards-based digital switching platforms. Summa Four's products support core network functions and interfaces, as well as rapid development and deployment of new services. Summa Four's Virtual Central Office (VCO) series of switches, part of its Project Sigma effort, support deployment of both wireline and wireless services, and thus, are targeted at CLEC, IXC, RBOC, and cellular service providers. Covered applications include calling card, messaging, single number dialing, intelligent call routing, and IP telephony.

  - The VCO product can function as a core network transport switching platform, or as a switch component of a service node for feature development. Once developed in the service node, the feature can be shared across the network. The VCO is offered in both 2000 and 4000 port versions to match the service provider's requirements. Summa Four supports its products with services such as design, development, testing, and deployment.

  - Cisco Systems' acquisition of Summa Four adds significant new capabilities to the programmable switch. Since Cisco's specialty is packet-based technologies, the integrated product line will support VoIP applications, delivering enhanced and value added services to packet-based networks.

- **Excel**

  Excel Switching Corporation provides open switching platforms for telecommunications service providers. The Expandable Switching System (EXS)™ is the technology framework for Excel's product line. It utilizes its patented Programmable Protocol Language (PPL)™ technology for quick and easy customization of generic switch software. It is based on Excel's Open Network Expansion (ONE)™ Architecture, which permits integration of switch functionality and advanced services as well as support for multimedia interfaces.

  - Excel's EXS™ efficiently integrates hardware and software. It is scalable and can support implementation options from 100 to 30,000 non-blocking ports. Products are targeted at entry-level, mid-range, and large customers. Growth can be managed by the service provider in an incremental, cost effective manner as the number and kind of customers increase.

  - EXS™ is supported with two particular software products: Call Control

and Resource. EXS™ Call Control permits off-loading of basic network routing from the host switch. This allows programmability at the call control level.

- The ONE™ architecture allows for the rapid development of services and solutions and is aimed at CLEC, IXC, wireless, and PCS providers. It is also targeted at developers of Advanced Intelligent Networks (AIN) and Enhanced Service Platforms (ESPs). ESP applications can be for local, tandem, and enhanced and Intelligent Network solutions. As services are developed via ONE, they are seamlessly integrated within the service provider's network and switches.

- In its White Paper on Open Network Expansion for Telecom Networks Worldwide, Excel summarizes the opportunity that programmable switches offer to service providers: "With ONE™ Architecture, carriers are no longer limited by the complexity of traditional, hierarchical switching networks. They are no longer dependent upon switch suppliers for new services, new network connectivity, or new media support. They are not required to invest in new platforms each time they expand their networks. And they are no longer limited to offering the very same services that their competition can offer!"[22]

c) Additional Switching Configurations Available to CLECs

The above sections demonstrate the variety of state-of-the-art products targeted by vendors at new local service providers. But beyond these product lines, switch and transmission equipment manufacturers are offering new entrants a number of additional options and architectures to build and grow their switch networks gradually, thereby reducing their need for large up-front infusions of capital. These options include host/remote architectures, remote access to switch functionality, Digital Loop Carrier (DLC), and PBX switching configurations. They all permit cost effective, efficiently managed delivery of service to discreet, distant locations and geographic groupings of customers -- such as Multi-Dwelling Units (MDUs), buildings, commercial office parks, shopping malls, and campus arrangements.

- **Host/Remote, Remote Access**. To reduce common equipment costs, many service providers use remote switches to extend the reach of hosts with high-capacity processors. New local service entrants will deploy one host and

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[22] *Open Network Expansion for Telecom Networks Worldwide* (Section 5.0) Excel Switching Corporation, at 1, located at http://www.xl.com/onewhp.

several remotes in each metro area they target. Remote capacity can range from less than 300 lines to up to 50,000 lines, depending on the CLEC's current and future business needs. There are a number of size variations on the low end of these products, with options such as pre-designed configurations with cabinet enclosures for ease of deployment. Many remote products can be upgraded to the vendor's full switch product, and any displaced equipment can usually be redeployed for a new remote opportunity. Distances between hosts and newly designed remotes are usually in the 600-mile range, with at least one planned product targeting a distance of 3000 miles.

- **Digital Loop Carrier (DLC) and Next Generation Digital Loop Carrier (NGDLC).** Nortel's AccessNode and DMS-1 Urban systems, Lucent's SLC®-2000 Access System, SLC®-Series 5, DSC's Litespan, AFC's UMC-1000 3GDLC, and RelTec's DISC*S® and Matrix™ Broadband Multimedia Access Platform are a few examples of DLC products that -- like host/remote switch configurations -- allow service providers to limit investment to a small number of switches while still providing a full range of services to a widely dispersed customer base. Selective deployment of DLC products enables the new local service provider to cost-effectively reach customers with full functionality in areas not served by a switch. For instance, AT&T has stated that a single switch can readily serve customers within a 125-mile radius when used with digital loop carrier.[23]

- **Private Branch Exchange (PBX) Configurations**. PBX equipment can be used by some service providers to deliver connections and features to small communities of interest. PBX trunks can be connected to IXCs for Long Distance, and ILEC, CLEC, and IXC Tandems for access to other in-region customers. Thus, PBX is yet another option to provide service while completely bypassing the ILEC local switch.

6. New Technology Options Allow A CLEC To Grow Its Network Efficiently

The architecture of today's technologies offers all categories of service providers cost-effective, feature rich, scalable switching platforms that can evolve to meet company specific business and market plan objectives. Remote access options facilitate reaching geographically dispersed customers, even when the number of customers is small. Modular availability of features and functions supports the development of attractive, state-of-the-art service offerings. Bandwidth flexibility with loop/access systems permits

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[23] *Petition of AT&T Corp. To Deny Application 24, GTE Corp., Transferor, and Bell Atlantic Corp. Transferee*, For Consent to Transfer of Control, CC Docket No. 98-184, November 23, 1998 at 24.

deployment of full broadband capability, at the initial rollout or over time.

With the right platform, a long distance provider can easily become a local service provider. It is often advantageous, in terms of network efficiencies and reductions in operations costs, for the established long distance provider to update to one of the newer, multi-function switching platforms. In fact, many service providers are announcing their migration to such "flattened" or "converged" networks. Likewise, with this same platform, a new local service provider can easily move into the long distance and data markets.

Internet and ATM networks can be easily integrated with the above local and long distance networks. Access networks that support both narrowband and broadband applications are integral parts of these networks. CATV companies and ISDN and xDSL technologies also provide efficient access to these Internet and ATM switching networks.

The reverse service migration path is also possible for Data CLECs with networks based on IP protocol. There are many products available today that overlay voice capabilities on such data platforms. There are also a significant number under development and in trial since this is one of today's hottest technical capabilities. When the Data CLEC offers service this way, its customers can often utilize pipes they have already purchased to secure the new voice offerings. Overall, the Data CLEC has a converged platform that permits efficient, financially attractive integration of multiple functions.

In short, today's telecommunications providers have a number of cost effective, appropriately-sized switching options that allow them to offer the services they desire in the necessary locations -- and in the required time frame. These options support all required functions with cost efficient interfaces across networks. New entrants are therefore able to build on their current investments, while continuously expanding the market segments they serve.

7. CLEC Provided Switching Functionality Is Available In All Geographic Markets

As discussed above, CLECs now provide their own switching functionality in all major MSAs and many smaller MSAs across the country. The ability to place remote switches and digital loop carriers further expands their ability to reach customers, and makes switching functionality available to CLECs in all geographic markets across the country. Attachments C and D illustrate this point.

Attachment C contains a map demonstrating that by deploying switches in only seven cities -- New York, Atlanta, Dallas, St. Paul, Denver, Los Angeles, and Spokane -- a CLEC can reach all the markets in the entire contiguous United States using Nortel's remote switching modules, which can be located up to 650 miles from the host.

A more conservative analysis was performed based on AT&T's premise that switching capability can be extended to a 125-mile radius using digital loop carrier (i.e., a remote switching module is not even necessary). Attachment D demonstrates that when the more conservative assumption of a 125-mile radius is used, virtually the entire eastern half of the continental United States can be reached by CLEC switches currently deployed along with most of the major cities and many smaller areas in the western half.

B. CLEC Self-Provisioning of Switches Is Not Cost Prohibitive

Switch cost assumptions have been a major source of controversy in State and Federal universal service and interconnection proceedings. As a result, there are a number of cost estimates available for conventional telephony switches typically being installed by the ILECs. In the past, it was widely believed that switch deployment by a telecommunications provider required a capital investment in the millions of dollars. Today, however, this is not the case. As discussed above, telecommunications providers have the ability to purchase switching functionality on a small-scale basis. As their requirements for capacity grow, they can grow their switch capacity incrementally. Thus, CLECs and other new entrants into the telecommunications market are able to purchase and in fact are purchasing their own switching functionality.

A review of the switching costs contained in the Synthesis Model adopted by the FCC for purposes of calculating Universal Service Costs provides an indication of what the FCC believes is a reasonable estimate of switching costs.[24] The FCC Model currently bases its USF calculations on a getting started cost of $447,000 for stand-alone and host switches, a getting started cost of $186,400 for remote switches with a per-line cost of $83 assigned to all three types.[25]

Similarly, the HAI model, sponsored by AT&T & MCI in numerous USF and UNE proceedings, demonstrates that these companies believe that the cost of self-providing switches is low.[26] The Model uses an algorithm that represents what it refers to as a "blended overall efficient mixture of host, remote, and standalone switches within the

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[24]In the Matter of the Federal-State Joint Board on Universal Service, In the Matter of the Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket No. 96-45, 97-160, *Fifth Report and Order*, FCC 98-279 (rel. Oct. 28, 1998).

[25]*FCC Synthesis Cost Proxy Model* (as released at www.fcc.gov/ccb/apd/hcpm on May 18, 1999).

[26]This in not to say that switches are *perfectly* scalable. They do have an up front cost component to cover. For example, the central processor unit of a host or remote switch must be present regardless of the number of lines served by the switch.

modeled network" to calculate switch costs when run in the default mode.[27] However, when run with the host/remote option enabled, the HAI model uses the following estimates for costs that "an efficient firm would incur to provide unbundled network elements ("UNEs"), universal service, and interconnection services."[28] The table below displays the switching costs calculated by the HAI Model for small Independent Telephone Companies (ICOs).[29]

TABLE 5: HAI 5.0a - Switch Costs for Small ICOs

line size	standalone fixed investment	standalone per line investment	host fixed investment	host per line investment	remote fixed investment	remote per line investment
0	$300,001	$129	$315,001	$129	$17,143	$146
640	$300,001	$129	$315,001	$129	$94,286	$141
5000	$300,001	$129	$315,001	$129	$120,000	$146
10000	$814,289	$124	$855,003	$124	$385,716	$120

Furthermore, there is early evidence that the currently emerging packet telephony switch market will reduce start-up costs even more significantly. For example, Lucent Technologies recently unveiled its PathStar Business Service Exchange, which provides voice and data services over IP or ATM packet networks. The PathStar is scheduled to begin shipping in July 1999, with prices starting at about $100,000 for an entry-level configuration.[30] Other industry information suggests that IP router prices will drop about 50 percent every 10 to 20 months. So a $100 IP port might cost only $50 in 18 months."[31]

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[27] *HAI Model Release 5.0a Model Description* §6.5.3.1, at 56 (Feb. 2, 1998).

[28] Direct Testimony of Brenda J. Kahn on Behalf of AT&T Communications of the Southwest, Inc., Before the Public Service Commission of Missouri, Docket No. TO-98-329 (June 30, 1998) at 7.

[29] The costs referenced in this discussion are espoused by FCC HAI Model sponsors. Neither GTE nor NECI necessarily agree that these costs accurately represent GTE's or any other ILEC's costs, however.

[30] Jeff Patryka and Paul Krill, *Packet telephony gets PSTN capabilities*, InfoWorld, May 3, 1999, at 28.

[31] Ike Elliot, Senior Director of Network Engineering of Level 3 Communications Inc.as quoted in *CLECS Toeing VOIP Waters*, by Gary Kim (May 1999) located at www.soundingboardmag.com/articles/951feat2.html.

C. CLECs That Provide Their Own Switching Functionality Are Experiencing Brisk Revenue Growth

One measure of CLEC success is the rapid growth in revenues that CLECs are experiencing. Table 6 below provides a synopsis of the revenue growth of selected CLECs -- all of which have chosen to expand some or all of their switching networks without relying on ILEC facilities. It is evident from these high revenue growth rates that CLECs are expanding their markets and successfully acquiring new customers.

TABLE 6: TOTAL REVENUE GROWTH OF SELECTED CLECS THAT PROVIDE THEIR OWN SWITCHING FUNCTIONALITY ($M)

CLEC	1995	1996	1997	1998	% Chg. 95-98	1Q 1999
21st Century Telecom Group	n/a	n/a	n/a	.94	n/a	1.125
Allegiance Telecom	n/a	n/a	n/a	9.8	n/a	10
Birch Telecom	n/a	n/a	n/a	22	n/a	10.6
Business Telecom, Inc.	114.5	148.8	195.0	212.5	85.6%	56.9
Cablevision Systems (Lightpath)	1,078	1,315	1,949	3,265	203%	934
CommNet Cellular	89.8	115.2	150.9	171.4	90.9%	n/a
Cox Communications	1,286	1,460	1,610	1,717	33.5%	498.5
Electric Lightwave, Inc.	15.7	31.3	61.1	100.9	543%	38.2
e-Spire	1.2	9.4	59	156.8	12967%	58.1
FirstWorld	n/a	n/a	n/a	1.1	n/a	8.26
Focal Communications	n/a	n/a	4.0	43.5	988%	26
Frontier Communications	2,144	2,576	2,353	2,594	21%	675
GCI of Alaska (General Communications)	129.3	164.9	224	246	90.3%	61.3
GST Telecommunications	n/a	41.3	106	163.3	295%	55.7

TABLE 6: TOTAL REVENUE GROWTH OF SELECTED CLECS THAT PROVIDE THEIR OWN SWITCHING FUNCTIONALITY ($M)						
Hyperion Communications	1.7	3.3	5.1	13.5	694%	26.5
ICG Communications	122.4	190.6	273.4	397.6	225%	129.5
Intermedia Communications, Inc.	38.6	103.4	247.9	712.8	1747%	204.7
ITC DeltaCom	5.8	66.5	114.6	171.8	2862%	53
McLeodUSA	29	81.3	267.9	604.1	1983%	181.1
MCI WorldCom	3,640	4,485	7,351	17,678	386%	9,001
MediaOne	2,374	2,955	5,043	2,882	21.4%	665
MGC Communications	n/a	n/a	3.8	18.2	379%	8.4
Pac-West Telecom	n/a	n/a	29.6	42.2	42.6%	14.4
RCN	92.0	104.9	127.3	210.9	129%	67.4
Time-Warner Telecom	6.9	23.9	55.4	121.9	1667%	47.6
US LEC	n/a	0.0	6.5	84.7	1203%	36.2
WinStar	29.8	68	79.6	244.4	720%	88.1

III. Analysis Of Transport Alternatives Available To CLECs

Today, there are alternatives available to CLECs that require interoffice transport capabilities. Advances in technology have afforded CLECs the opportunity to economically construct their own facilities, and many have done so. In addition, numerous suppliers of interoffice facilities -- such as Interexchange Carriers, Competitive Access Providers, and CLECs -- are leasing their surplus facilities to CLECs and other telecommunications providers. Manufacturers are also providing products to the many "niche" markets that are emerging.

A. CLECs Are Providing Their Own Interoffice Facilities

Research indicates that many CLECs are providing their own interoffice facilities rather than leasing them from alternate providers. While spectrum owners like WinStar, Teligent, TGC (now part of AT&T), and NEXTLINK are using 38-Ghz digital radio systems,

CLEC interoffice transport is furnished almost exclusively over fiber-optic cable facilities.[32] For instance, Dakota Services, LTD. has a national data network consisting of ATM, frame relay, DS1 to DS3, and fiber-optic direct links. Its technology platform provides a secured dedicated LAN connection that can span across a LATA or across the country.[33] Similarly, Cablevision Lightpath provides a full-range of local, switched services, private line, and advanced networking features on the local and long distance levels over its own facilities and networks.[34] And BTI Telecommunications Services is constructing a 3,250-mile long-haul fiber network.[35] It now has fiber in service between New York City and Washington, D.C., and from Rocky Mountain to Charlotte, North Carolina. It carries a substantial percentage of its North Carolina traffic on its own fiber network. The company's entire fiber network is to be completed from New York to Miami, and from Atlanta to Nashville, by the end of the second quarter of 1999. BTI also intends to provide wholesale services to other telecommunications carriers.[36]

The majority of CLECs that are self-provisioning transport over fiber-optic facilities are doing so using Synchronous Optical Network (SONET) technology. The SONET architecture is favored because of its inherent flexibility, survivability, scalability, and lower relative cost compared to asynchronous transport technologies. In a SONET system, each individual customer signal, or "synchronous payload envelope"[37] is directly accessed by less expensive "add-drop" multiplexers located at nodes along the SONET ring. Spurs can be extended from the ring to additional "off-ring" nodes that are located outside the ring. And traffic can be shared between different rings at common nodes.

As to survivability, the SONET architecture is designed to provide uninterrupted service in the event of a fiber or electronics failure. Each multiplexer on a SONET self-healing ring transports its traffic in two directions along the ring. For instance, the active channel may transit the fiber-ring in a clockwise direction while the standby channel leaves

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[32]Industry Analysis Division of the Common Carrier Bureau, *Trends in Telephone Service* (Feb. 1999) (Table 18.3), FCC Website, www.fcc.gov/ccb/stats.

[33]http://www.dslnet.com/About_Dakota/Press_Releases/February_1_1998/body_February_1_1998.html.

[34]Cablevision Website, http://www.cablevision.com/cvhome/cvphone/phone.htm.

[35]Since the CLECs are unencumbered by LATA boundaries, these " long-haul" networks are used for both inter-LATA and intra-LATA transport.

[36]BTI Website, http://www.btitele.com/new/release.cgi?timestamp=920264401.

[37]"The payload is the revenue-producing traffic being transported and routed over the SONET network." http://www.webproforum.com/tektronix/topic03.html.

the node in a counterclockwise direction. In the event of a fiber failure anywhere along the ring, the system instantaneously switches all affected traffic to the alternate signal path.

The scalability of the SONET-fiber technology is a result of two factors. *First*, capacity can be added incrementally to SONET systems by adding (rather than replacing) electronics. The typical, entry-level SONET system operates at the OC-3 rate of 155 Mbits per second or 84 DS1s. The 1.544 Mbit DS1 rate is generally the lowest transport speed required, because all digital switches available today interface the network at this rate. These systems can be upgraded to OC-12 (622 Mbit, 336 DS1s), OC-48 (2.4 Gbits, 1344 DS1s), and OC-192 (10 Gbits, 5376 DS1s). Most products available today allow such upgrades to be done "in-service."

Second, the number of individual wavelengths (or colors) that each fiber carries can be increased through the use of wave division multiplexing. Transmission rates of 40 Gbits per second on a single fiber are achievable today using products like CIENA's Multiwave 1600 Terminal, which allows up to 16 OC-48 channels to be carried over a single fiber. And the future brings the promise of even greater capacity. Lucent has successfully tested a 1 terabit (1 trillion bits) fiber-optic transmission system. The advantage of using these state-of-the-art technologies is clear: Once the initial investment in the fiber infrastructure is made, capacity for new and growing customer demand can be added at a relatively low incremental cost.

The table below contains a sample of CLECs that provide their own transport functionality. It is interesting to note that even though this is only a small sample, these CLECs are operating in most major and in many smaller markets. It is important to note that several of these CLECs are also providing their own loop facilities on SONET Fiber Rings.[38] This is another major advantage of this technology. It is service-independent or transparent. That is, the same SONET rings can be used to carry both loop and interoffice traffic by placing nodes at any switch site or customer location along the ring path.

TABLE 7: SELECTED CLECs PROVIDING THEIR OWN TRANSPORT FACILITIES

CLEC	TYPE OF CLEC	MSA RANKING(S)
Allegiance Telecom	Traditional	1-7,9,10,11
AT&T	Traditional/Wireless	1,2,3,4,5
Bay Ring Communications	Traditional	7
Birch Telecom	Traditional	18,24
BTI	Traditional	1,4,11,12,32,38,200
Cablevision Systems (Lightpath)	Cable/Telephony	1
Caprock Communications	ICP	9,28,33,42,45,62,72, 148,156,160, 216
Electric Lightwave, Inc.	Traditional	2,13,22,25,34,35,95, 103
e-Spire	Traditional	1,4,9,101
FirstWorld	Traditional	2
Focal Communications	Traditional	1,2,4,5,6,7,
Frontier Communications	Traditional	1-9,11,13,16,17,18,20, 21,24,26,40,60,103
FTV Communications	Traditional	2,17

[38] *See* Section IV *infra.*

TABLE 7: SELECTED CLECs PROVIDING THEIR OWN TRANSPORT FACILITIES		
GST Telecommunications	Traditional	2
Hyperion Communications	Traditional	1,4,6,12,19,21,33,36, 41,43
ICG Communications	Traditional	2,5,17,42,101
Intermedia Communications, Inc.	Traditional	42
ITC DeltaCom	Traditional	9,21,30,76,145,155, 151
KMC Telecom Corp.	Traditional	8,16,37,71,74,81,82, 85,98,99,101,102104, 116,130,135,155,183
Level 3	Traditional/Wholesale	1-11,13,17,20
McLeodUSA	Traditional/Wireless	18,29,92,159,171,234, 252
MCI WorldCom	Traditional	1-30,40,41,42,43,46, 50,54,56,57,58,62,63, 64,68
MediaOne	CATV/Telephone	2,12,16,203
PaeTec	Traditional	1,2,4,5,6,7,12,21,40, 44,54,100
Qwest	Traditional/Wholesale	1,2,25
RCN	CATV/Telephone	4,5,7,17
Teligent	Wireless	2,4,5,6,7,9,10,11,12, 20,21,26,33,40,41,42, 43,45,57,59,60
Time-Warner Telecom	CATV/Telephone	1,17,21,23,29,40,41,42 ,43,54,55,
Touch America	Traditional/Wholesale	9,20,35
WinStar	Wireless	1-18,21,22,24,26,33
See Appendix A for table sources.		

B. Interoffice Facilities Are Widely Available From Wholesale Providers

In addition to constructing its own transport facilities, CLECs in many markets also have the option of leasing transport capacity from wholesale providers that are leveraging the essentially limitless capacity of their embedded fiber networks to generate additional revenues. Companies such as Touch America, Williams, and Qwest Communications, to name a few, have spare capacity on their interoffice networks and lease this capacity to CLECs and other telecommunications providers. As described below, many of these companies offer their services on a nationwide basis, thereby making interoffice transport alternatives widely available.

- **Touch America**
  Touch America has significant transport facilities in all major MSAs in the Northwest, including MSAs in Washington, Oregon, Idaho, and Wyoming, as well as in Wisconsin. They also have covered the largest cities on the West Coast. Future expansion plans include New Mexico, Texas, and Arizona. They also plan to link New York City with Chicago and Kansas City.[39] In addition, Touch America is constructing a $50 million Salt Lake City-Denver-Dallas expansion to add to its existing 10,000 mile fiber optic network. It has pre-sold capacity on the 1,029 mile Denver-Dallas leg of the expansion.[40] Touch America's total 1999 fiber network installed or under construction is expected to be 12,000 miles.

- **Williams Telephone**
  Williams Communications has recently partnered with Pacific Fiber Link to construct a 715 mile fiber-optic loop, linking Sacramento to Portland. In return for their $47.2M investment, Williams will have access to all network facilities along the route. Moreover, in a December 1998 press release, Williams announced that they have inked a deal with WinStar to provide WinStar access to Williams' planned national network. The deal was valued at $640M. Similar deals have been struck with Touch America.[41] ATM transport and backbone connectivity are two of the most important issues for Williams Telephone's wholesale customers. ATM transport is used to integrate multiple services and transmit video across the company's network. Backbone connectivity makes it possible for NSPs, ISPs, RBOCs, and

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[39] clec.com, http://www.clec.com.

[40] *Touch America to Expand Fiber Network from Salt Lake to Denver to Dallas* (located at http://mpc.in-tch.com:30080/headlines/1999_Releases/02-22-99.htm) (Feb. 1999)

[41] clec.com, http://www.clec.com.

CLECs to build and extend the geographic presence of their networks.[42]

- **Qwest Communications**
  Qwest Communications of Denver has expanded its fiber network to include over 32 major MSAs across the United States. They have a footprint covering the entire East Coast, including Boston, New York, Philadelphia, Charlotte, Atlanta, Tampa, Jacksonville, and Miami. The heartland is also targeted in Detroit, Cleveland, Columbus, Cincinnati, and others. The West Coast footprint includes, but is not limited to, Seattle, Portland, Sacramento, Los Angeles, San Diego, and Tucson. And plans are underway into expand to second and third tier MSAs across the United States. In addition, many agreements have been signed for cooperative use of spare bandwidth with such companies such as Covad, e-spire, Hyperion, and STAR.[43]

- **Metromedia**
  Metromedia Fiber Network operates a 380,000-mile fiber-optic communications network in the New York City Metropolitan area and in Chicago, Philadelphia, and Washington, D.C. It provides access to its network through lease arrangements with communications carriers, including local exchange, long-distance, paging, cellular, PCS providers, cable companies, ISPs and corporate and government customers.[44]

- **Electric Lightwave**
  Electric Lightwave owns and operates Metropolitan Area Networks (MANs) in Seattle, Spokane, Portland, Sacramento, Phoenix, Salt Lake City, and Boise. It builds and operates all-digital, high-speed fiber-optic networks for businesses and long-distance carriers across the United States.[45]

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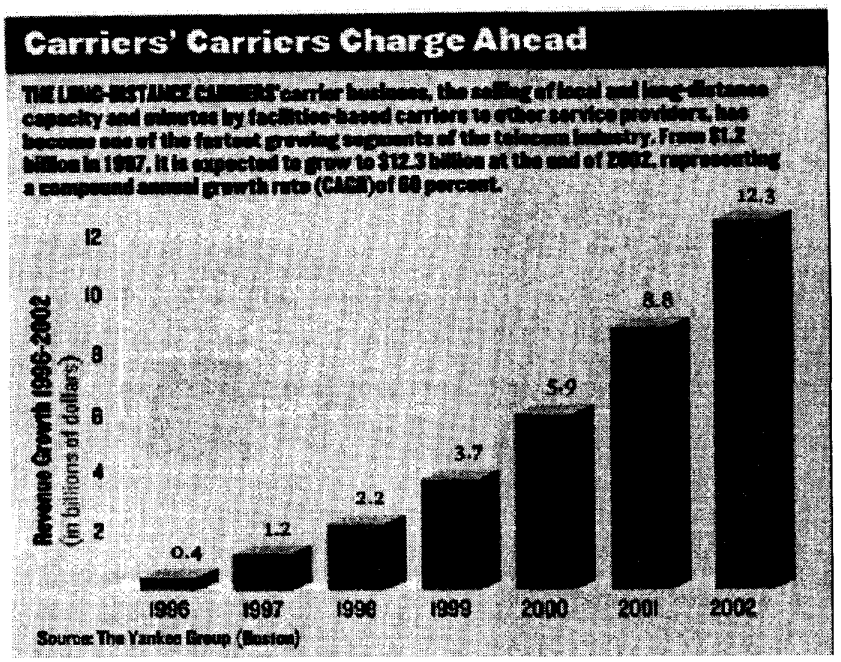
[42]http://www.willtales.com/network/non_flash/products/atm/index.html.

[43]clec.com, http://www.clec.com.

[44]*Id.*

[45]Electric Lightwave Website, http://www.eli.net/about.html.

The chart below demonstrates the rapid growth in the type of serving arrangements discussed above.[46] As depicted in the chart, with an expected growth rate of 60% between 1996 and 2000, this has become one of the fastest growing segments of the telecom industry. This chart offers strong proof that telecommunications providers are taking advantage of the alternatives available in the marketplace for their interoffice facilities requirements.



In addition to wholesale providers, there are a number of niche companies that have emerged to provide telecommunications services to the CLECs. These carriers typically offer services either locally or regionally, and differentiate themselves with unique, lower-priced services.

One of the newer niche services to surface in the industry is the "Collocation Hotel." Companies like Colomotion, Inc., the Colocation Corporation, and Switch and Data Facilities provide neutral "hotels" where carriers can interconnect with each other (rather than having to interconnect at the ILEC premise). These facilities are ideal locations for SONET Ring intersections between CLECs and their wholesale transport, loop, and interconnect partners. In addition, some CLECs and ISPs are also allowing other CLECs to collocate in their offices. "Colomotion is the first carrier-neutral, collocation facility

[46]Tele.com magazine, January 25, 1999, at 38.

offering a solution for ISPs and other Internet-based companies to share emerging technology, bandwidth allocation, transit costs, peering and multiple access methods under one roof. Colomotion customers and partners are provided with a secure scalable, non-congested Internet exchange point."[47] These unique sites provide CLECs, ILECs, long-distance carriers, and other carriers a neutral location to interconnect, thereby eliminating the need to use ILEC central offices.

C. CLEC Transport Alternatives Are Not Cost Prohibitive

Like switch cost assumptions, transport costs have been discussed in some detail in State and Federal universal service and interconnection proceedings. Each of the models proffered by the various parties to these proceedings contain estimates of the costs associated with the installation of interoffice network components.

The chart below, which contains cost estimates from both the FCC universal service model and the HAI model sponsored by AT&T & MCI,[48] demonstrates the Commission and IXCs belief that a relatively small up-front investment in fiber infrastructure will provide seemingly unlimited capacity for future growth. (See Attachment E for an illustration of the assumed network topology.)

HAI COST FOR A ONE-HUNDRED MILE, FOUR-NODE, OC-3 FIBER RING			
Item Description	**Unit Cost**	**Quantity**	**Extended Cost**
24-fiber cable[49]	$3.50	528,000	$1,848,000
Structure (blended, per foot)	$1.87	528,000	$987,360
Optical Patch Panel	$1,000	4	$4,000
Fiber Pigtail	$60	16	$960
OC-3/DS1 ADM	$26,000	4	$104,000
OC-12 ADM	$40,000	0	$0

[47]Colomotion Website, http://www.colomotion.com.

[48]These costs are espoused by the Model sponsors. Neither GTE nor NECI necessarily agree that these costs accurately represent GTE's or any other ILEC's costs, however.

[49]The default number of fibers assumed by the HAI Model for an interoffice fiber cable is 24. *HAI Model Release 5.0a, Inputs Portfolio* (Jan 27, 1998) §4.4.2.

HAI COST FOR A ONE-HUNDRED MILE, FOUR-NODE, OC-3 FIBER RING			
OC-48 ADM	$50,000	0	$0
EFI @ 32 Hrs/Site	$1,760	4	$7,040
Total			**$2,951,360**

This system provides capacity for 84 DS1s (2,048 voice grade equivalent circuits) traversing the ring over four fibers. Additional capacity can be added by placing additional OC-3 systems on the 20 spare fibers, by upgrading the electronics to OC-12, OC-48, or even OC-192 capacity, or by placing wave division multiplex devices at each site to enable several systems to share the same fiber. This could be scaled to over 12 million circuits using technology available today, although it is highly unlikely that traffic between four offices would ever reach these levels.

This example also provides insight into the motivation of wholesale transport providers. Once the initial infrastructure investment has been made, the incremental investments for capacity upgrades are relatively small. For example, to quadruple the capacity of the transport network illustrated in the table above, the four OC-3 ADMs could be converted to OC-3/DS1 Terminal and augmented with 12 additional terminals at $26,000 each and 4 OC-12 ADMs at $40,000 a piece, for a total incremental investment of just $480,000 (or a 16% increase in total investment). It is important to note that the original OC3 investment is fungible; that is, the equipment is reused in the upgrade process rather than replaced.

D. CLECs That Choose Transport Alternatives Are Experiencing Rapid Revenue Growth

The table below highlights the revenue growth of selected CLECs that choose to use transport alternatives. It is evident from the revenue growth presented in the table that these CLECs are expanding their operations at a very rapid pace.

TABLE 8: TOTAL REVENUE GROWTH OF SELECTED CLECS THAT PROVIDE THEIR OWN TRANSPORT FACILITIES ($M)

CLEC	1995	1996	1997	1998	% Change 95 - 98	1Q 1999
Allegiance Telecom	n/a	n/a	n/a	9.8	n/a	10
Birch Telecom	n/a	n/a	n/a	22	n/a	10.6
Business Telecom, Inc.	114.5	148.8	195.0	212.5	85.6%	56.9
Cablevision Systems (Lightpath)	1,078	1,315	1,949	3,265	203%	934
Caprock Communications	n/a	n/a	n/a	121.8	n/a	37
Electric Lightwave, Inc.	15.7	31.3	61.1	100.9	543%	38.2
e-Spire	1.2	9.4	59	156.7	12967%	58.1
FirstWorld	n/a	n/a	n/a	1.1	n/a	8.26
Focal Communications	n/a	n/a	4.0	43.5	988%	26
Frontier Communications	2,144	2,576	2,353	2,594	21%	675
GST Telecommunications	n/a	41.3	106	163.3	295%	55.7
Hyperion Communications	1.7	3.3	5.1	13.5	694%	26.5
ICG Communications	122.4	190.6	273.4	397.6	225%	129.5
Intermedia Communications, Inc.	38.6	103.4	247.9	712.8	1747%	204.7
ITC DeltaCom	5.8	66.5	114.6	171.8	2862%	53

TABLE 8: TOTAL REVENUE GROWTH OF SELECTED CLECS THAT PROVIDE THEIR OWN TRANSPORT FACILITIES ($M)						
McLeodUSA,	29	81.3	267.9	604.1	1983%	181.1
MCI WorldCom	3,640	4,485	7,351	17,678	386%	9,001
MediaOne	2,374	2,955	5,043	2,882	21.4%	665
RCN	92.0	104.9	127.3	210.9	129.2%	67.4
Teligent	n/a	1.4	3.3	1.0	(28.6%)	1.5
Time-Warner Telecom	6.9	23.9	55.4	121.9	1667%	47.6
WinStar	29.8	68	79.6	244.4	720%	88.1

IV. Analysis of Loop Alternatives Available to CLECs

CLECs currently have a significant number of conventional and emerging technology options at their disposal in lieu of purchasing or reselling local loops obtained from incumbent LECs. And the number of loop alternatives available to CLECs is increasing at a rapid pace. This is due in part to the new technologies that are available with a broad range of feature options from an ever-increasing number of manufacturers. These new technologies -- which include Access Systems, digital and fiber-optic Multiplexer arrangements, Transmission systems, Pair-Gain Systems, xDSL, and Digital Loop Carrier Systems -- can be obtained in various quantities and at a broad range of prices. In addition, recent merger and partnership activity in the telecommunications industry sends a clear signal that CLECs intend to provide their own local loops in many markets across the United States. Finally, the emergence of new radio technologies is enabling CLECs to use wireless local loops to reach their customers. The information presented below demonstrates that there are local loop alternatives available across the United States -- alternatives that CLECs are taking advantage of in many markets.

A. CLECs Are Providing Their Own Local Loops

Rather than purchasing loops from an ILEC or a wholesale provider, some CLECs are opting to construct their own loop networks. This is true in both urban and suburban areas, where CLECs and CAPs have proven that it is feasible to build their own fiber networks, and in rural areas, where companies are deploying "fixed wireless" networks.

As with transport facilities, the majority of CLECs that are self-provisioning loops are doing so using Synchronous Optical Network (SONET) Fiber Rings. Since the SONET topology provides ready drop and insert access to individual DS1 payloads, this architecture is ideal for serving business customers with requirements of 20 or more lines.

The 24-channel DS1 (or T1) loops are generally priced less than 20 or more individual business lines.

The inherent flexibility, survivability, scalability, and lower relative cost of SONET fiber networks, as described in the transport section of this paper, also applies to the loop network. Likewise, the economic advantages of using these state-of-the-art technologies are equally applicable. Once the initial investment in the fiber infrastructure is made, capacity for new and growing customer demand can be added at a relatively low incremental cost. With regard to scalability, RCN's network build-out strategy is a good illustration of today's fiber technology: "We're building networks on the '80/20' model. That is, we're utilizing less than 20% of our network capacity. That means we have enough fiber to support over 80% more capacity than what our four services require today. Why? As more Internet-based and inspired applications are invented -- and they will be -- we can sell more products and services without having to upgrade our infrastructure. That leads us into a virtuous circle, where we can increase our revenue with little or no capital investment."[50]

In addition to traditional fiber-optic cable technology, companies are beginning to deploy "fixed wireless" technology to reach their customers in urban, suburban, and rural areas. WinStar and Teligent are using 38 Ghz digital microwave radio systems to offer point-to-point DS1 and DS3 links to provide local, long distance, Internet and data services to their business customers. Since there is no need to dig up streets or obtain rights-of-way to place cable, these digital radio systems can be installed and turned up in days, rather than weeks or months. It is projected that fixed wireless service spending will skyrocket from $6 million in 1999 to $679 Million in 2002.[51] Even AT&T plans to use fixed wireless technology to serve customers where its cable-TV lines do not reach.[52]

Like the SONET fiber rings, these digital microwave radio systems are ideally suited to customers requiring 20 lines or more, because a single DS1 channel carrying up to 24 equivalent voice-grade channels can be economically provided and rapidly augmented as additional capacity is required. In addition, since the transport is all digital, Internet, LAN, WAN, and video traffic can be easily accommodated.

In the residential market, CATV companies have augmented their existing coaxial cable networks with fiber and are actively marketing telephone services over their upgraded facilities, thus demonstrating the feasibility of "cable telephony." AT&T has

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[50]RCN 1998 Annual Report, Letter to Shareholders from David C. McCourt.

[51]1999 MultiMedia Telecommunications Market Review and Forecast, TR Daily, March 8, 1999.

[52]*AT&T to Enter Some Local Markets Using Its "Fixed Wireless" Technology*, Wall Street Journal, Mar 19, 1999, at B6.

announced its intention to offer residential telephony over facilities acquired in its mergers with TCI and MediaOne and in its partnership with Time Warner. AT&T's newly and soon to be acquired facilities pass by 26.5 million homes and Time Warner's facilities pass another 20 million, giving AT&T access to approximately 60% of the households in the U.S.[53] Accordingly, AT&T's Chairman, C. Michael Armstrong has touted its latest acquisition of MediaOne as meaning that "[f]ar more American consumers will have a choice of local telephone service."[54] However, none of the CATV companies are currently offering wholesale loop UNEs. In fact, AT&T has been openly hostile to suggestions that it be compelled to offer unbundled loop UNEs to competitors.[55]

But the CLECs that are providing service over their own loop facilities are not just limited to the examples above. The following quotation from a recent *Outside Plant* magazine editorial provides a few more examples, and explains the motivation of these companies: "Today, you can't help but notice the trend of CLECs installing their own infrastructure. I've watched 21st Century here in Chicago install their network along the right-of-way of our mass transit rail system. Elsewhere, IXC, Allegiance, Qwest, Frontier and others are installing networks at a large expense. They all hope to grab a portion of the billion dollar voice and data market."[56]

In fact, the ubiquity of an ILEC's embedded loop plant does not guarantee that CLECs will be able to provide the services their customers' desire. Quite often, particularly in suburban and rural areas, the ILEC's loop will have loaded copper pairs that require expensive and time consuming conditioning before they can be used to provide the services the CLECs are marketing. In urban and dense suburban areas, the ILEC cable facilities may contain "recognized disturbers, such as AMI T1" which the Commission believes "should, to the fullest extent possible," be replaced with new and less interfering technologies.[57] For some CLEC services -- *e.g.*, DS3 transport and FDDI -- the ILECs embedded loop facilities cannot be used at all. This is one reason why, as discussed above, CLECs are opting for facilities-based network elements. By providing their own

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[53]AT&T Website, http://www.att.com/press/item/0,1193,439,00.html.

[54]*Id.*

[55] In a recent press release, AT&T Chairman C. Michael Armstrong protested that, " [n]ocompany will invest billions of dollars to become a facilities-based broadband services provider if competitors who have not invested a penny of capital, nor taken an ounce of risk, can come along and get a free ride on the investments and risks of others." *Armstrong Fires Back at Critics of TCI Deal*, TR Daily, March 1999.

[56]Sharon Stober, *Digging Deeper*, Outside Plant, Dec. 1998, at 6.

[57]In the Matters of Deployment of Wireline Services Offering Advanced Telecommunications Capability, CC Docket No. 98-147, First Report and Order and Further Notice of Proposed Rulemaking, FCC 99-48, at 74 (rel. March 31, 1999).

loops in conjunction with the new technologies discussed below, CLECs can more efficiently target their high-margin customers with a multitude of advanced digital services as well as traditional voice telephone. These new technologies include:

- Lower-cost NGDLC digital loop carrier systems[58]
- Integrated Access Terminals
- Digital Subscriber line (DSL or xDSL)
- SONET Fiber Rings
- Hybrid Fiber Coax Systems
- Wireless Access: Fixed Wireless Local Loop; Digital Microwave Radio; Cellular/PCS

While some of these technologies are designed to extend the capabilities of the existing copper infrastructure -- *e.g.*, xDSL and small DLC systems -- many companies, offer low cost, feature-rich alternatives to traditional technologies using fiber or radio spectrum. For example, Alcatel USA (formerly DSC Communications) has augmented its Litespan 2000 NGDLC System with the fiber-based Starspan ONU-24 and the copper-based Litespan 200 System, which it advertises as a cost-effective, rapid deployment solution for small line-size applications. Both of these products can be used to extend service to customers outside of the fiber rings on which Litespan 2000 is deployed. In addition, Lucent Technologies has augmented its SLC 2000 NGDLC System with its AnyMedia Access third generation digital loop carrier system, which works over fiber, copper, or wireless media. Lucent claims that this platform can reduce service delivery costs by more than 20%. And Advanced Fiber Communications, Inc. has combined its newly developed digital spread spectrum radio system with its UMC-1000 3GDLC system to provide wireless connectivity.

Significantly, the ability of the CLECs to offer their customers a full range of services over modern digital facilities often provides them a competitive edge over the ILECs. According to David McCourt, Chairman and CEO of RCN Corporation: "RCN sees those opportunities. We're making bold moves. We're building a new network with lower operating costs. The telco incumbents are still operating networks that depend on twisted copper wires and technology invented more than 100 years ago. To be sure, the incumbents are spending billions to upgrade their networks. But retrofitting 19th century technology to meet the needs of the 21st is like trying to keep an old car roadworthy for superhighway speeds. The result is a vicious circle, where you have to keep putting more money into the network before you can increase revenues. We don't do that. Our network

[58]In a March 29, 1999, FCC Ex Parte, AT&T submitted cost documentation for small fiber DLC systems (up to 240 lines) stating, " [I]n contrast to the input values for 24-line DLC now existing in the SM's test data set, modern small DLCs are priced much more economically."

already has plenty of excess capacity."[59]

The table below contains a representative listing of facilities-based CLECs, by area and facility type. It demonstrates that CLECs are reaching customers over their own facilities in most major markets in the United States. This type of facilities-based arrangement will become more prevalent as the market further develops and industry consolidations continue to occur. The availability of new technologies and the continued upgrade of CATV facilities, which currently pass more than 90% of the homes in the U.S., will also further the proliferation of facilities-based loop providers.

TABLE 9: SELECTED CLECs PROVIDING THEIR OWN LOOP FACILITIES

CLEC	TYPE OF CLEC	TECHNOLOGY	MSA RANKING OF LOCATIONS ( ) = # cities in MSA
21st Century Telecom Group	Cable/ISP/Local/LD	Fiber Optic Ring	3
American MetroComm	Local/LD/ISP/ISDN	Fiber Optic Ring	33
AT&T	Local/LD	SONET Fiber Rings (10,000 miles)	300 Communities including: 1, 2, 3, 4(2), 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 29, 30, 32, 35, 36, 39, 51, 53, 61, 63, 88, 133
Cox Communications	Local/Cable	HFC	1, 4, 15, 17, 61
Electric Lightwave, Inc.	Local/Data/ISP/ATM/ Wireless/Video	SONET Fiber Rings	Eighty-four (84) municipalities in western United States. These full service markets include: 13, 15, 22, 25, 35, 103

[59]Letter to Shareholders from David McCourt, RCN 1998 Annual Report.

TABLE 9: SELECTED CLECs PROVIDING THEIR OWN LOOP FACILITIES			
CLEC	**TYPE OF CLEC**	**TECHNOLOGY**	**MSA RANKING OF LOCATIONS ( ) = # cities in MSA**
e.spire	Local/LD/Cable Data/Internet	SONET Fiber Ring	4, 9(2), 21, 24, 28, 31, 33, 34, 42, 44, 48, 52(2), 53, 57, 58, 60, 62, 71, 72, 76, 79(2), 80, 88, 91, 93, 101, 119, 156
GST Telecommunications	Local/LD/ISP ATM/OS	Fiber	2, 5, 10, 13, 15, 22, 57, 62, 95
Logix	Wireless/ISP/CPE/data	Fiber Optic Ring	45
MediaOne	Local/Cable/ISP	HFC	2, 7, 11, 12, 44, 50
Nextlink		Fiber	1(2), 2, 3, 4, 5, 6, 9, 11, 12, 13, 15, 20, 22, 23, 35, 38, 41, 66, 86, 111, 130, 226
McLeodUSA	Local/LD	SONET Fiber Ring	3, 26(2)
RCN	Local/LD/Cable/ISP	SONET Fiber Backbone	1, 4, 6, 7, 17
Time Warner Telecom	ISP	SONET Fiber Rings	1, 10, 17, 21, 23, 26, 28, 29, 30, 32, 37, 40, 41, 42, 43, 55, 133, 139, 237
Teligent	Local/Data/ISP Wireless	Digital Microwave	1(3), 2(2), 3, 4(3), 5, 6, 7, 8, 9, 10, 11, 12, 13, 14(2), 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27(2), 28, 29, 30, 31, 32, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 47, 48, 49, 50, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 67, 70, 71, 73, 78, 83, 100
Touch America	Local/LD/ISP	LMDS and Fiber	223 (2) (planned 30 city build out)

TABLE 9: SELECTED CLECs PROVIDING THEIR OWN LOOP FACILITIES			
CLEC	**TYPE OF CLEC**	**TECHNOLOGY**	**MSA RANKING OF LOCATIONS ( ) = # cities in MSA**
WinStar Communications	Local/Data/LD/ISP Wireless	Digital Microwave	1(2), 2, 3, 4(2), 5(2), 6, 7, 8, 9(2), 10, 11, 15, 17, 26 (Planned - 1, 2, 3, 12, 13, 14, 16, 18, 20, 21, 24, 31)
See Appendix A for table sources.			

B. CLECs Are Purchasing Local Loops From Wholesale Providers

In today's telecommunications environment, there are a number of providers that offer alternative loop elements to ILECs, CLECs, IXCs, and ISPs on a wholesale basis in metropolitan areas. In this type of arrangement, the CLEC and the wholesale provider choose a mutually agreed upon point of interconnection and form of handoff. The point of interconnection could be the CLECs' site, the wholesale provider's site, or some other mutually agreed upon location (such as "collocation hotels" discussed in Section III). The parties also agree upon the form of handoff: fiber or T-1, DSO level or something higher. And the modern digital facilities provided by the wholesalers permit CLECs to offer essentially any service, from voice telephony to broadband data and video.